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REPRINT

FROM

THE BRITISH JOURNAL

OF

EXPERIMENTAL

PATHOLOGY

VOL. IV, No. 1. FEB., 1923.

LONDON: H. K. LEWIS & CO. LTD., 136, GOWER STREET, W.C.1.

EDITORIAL AND PUBLISHING OFFICE: 28, GOWER PLACE, W.C.1.

CANADA: THE MACMILLAN COMPANY OF CANADA, LTD., BOND STREET, TORONTO.

Annual Subscription, January to December, post free, Two Pounds net.

Single Numbers, Seven and Sixpence net.

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THE SCHICK TEST AND ACTIVE IMMUNISATION.

R. A. O'BRIEN, A. J. EAGLETON, C. C. OKELL AND MISS M. BAXTER

From the Wellcome Physiological Research Laboratories, Beckenham, Kent.

Received for publication January 10th, 1923.

It will probably be some considerable time before the people of any large city in England are so alive to the importance of the more recent measures for the control of diphtheria that they will freely allow their children to be tested by the Schick method, and if found to be positive reactors to be given the three doses of a toxin-antitoxin mixture. In the remarkable campaign carried out recently in New York some ninety thousand children were tested and if positive immunised, 70 per cent. of the parents giving consent.

However, these new measures are slowly but surely being adopted in England, and a review of the results obtained is probably sufficiently important to merit publication at this stage. Leete (1920), Ward (1921), Dickinson (1922), Harries (1922), Dudley (1922), and Copeman with the present authors (1922) have given the results of Schick tests.

To these series we have to add tests on 2769 individuals (see Table I).

TABLE I.—*Results of Schick Tests.*

Adults.	Number tested.	Percentage negative.
Medical students—a London teaching hospital	160	35
Nurses—a London teaching hospital	48	49·5
Nurses—School A	182	78
„ „ B	59	74
Children.		
School B	739	72
„ C	329	69
An institution for children	1046	62
Good class private school	53	28
Infant welfare centre	153	24

The results closely resemble those obtained elsewhere, the groups from a “higher” social stratum showing a lower degree of immunity than those from a “lower,” while the children, mostly aged from one to five years, from the infant welfare centre came from a district in which there has been but little diphtheria for some time past.

Apparently the children of the well-to-do are carefully guarded in their early lives, and escape the chance of the frequent mild attacks of unrecognised diphtheria which would otherwise eventually cause them to become immune. In a similar manner the children of intelligent artisans who live in well-kept homes in a district where few cases of diphtheria have occurred in recent years “escape” or “avoid” natural immunisation.

Age distribution.—Our general results agree with those reported in the literature, the immunity rate rising during the years of childhood and becoming constant in early adult life. The deviations in each individual group are associated with the special conditions of the group, or in some cases are probably due to the smallness of the statistical units.

Familial immunity.—As observations accumulate it may become possible to decide whether there is a family factor in the readiness with which immunity is developed. Unfortunately the observations hitherto recorded are insufficient to throw much light upon this point. When immunising 107 families, we found in 20 that the children were positive reactors; in 54 all negative; in 20 the older negative and the younger positive in accordance with Zingher's observations; and in 13 (12 per cent.) the older children positive, while the younger were negative. The members of these 13 families did not live together during the whole of their lives.

In one group of 136 children, all of whom originally gave a Schick-positive reaction, there were only three individuals who failed to give a negative Schick reaction within 11 weeks of the commencement of the “immunisation”; of these two were brother and sister, and both proved refractory until 21 weeks had elapsed. The remaining one was still Schick-positive after this interval.

Twins.—We tested three pairs of twins; each twin gave the same reaction as the other in two cases; the twins were similar and less than three years

old. Of a third pair of dissimilar twins, aged 7 years, the boy was a positive reactor and the girl negative.

RESULTS OF IMMUNISATION.

The routine procedure was to give a weekly intramuscular injection of 1 c.c. of toxin-antitoxin mixture until three doses had been given. At different intervals after the last injection small groups of these children, as they became available, were subjected to the Schick test.

TABLE II.—*Results of Immunisation.*

		Weeks elapsed between last injection of toxin-anti-toxin mixture and first negative response to Schick test.							
		1	2	3	4	5	6	7	8
School B :									
Initial immunity rate 72 per cent.									
	Number tested .	19	56	37	4	20	3	1	1
	„ negative .	17	46	31	4	16	3	1	1
	Percentage negative	89	82	84	100	80	100	100	100
School C :									
Initial immunity rate 69 per cent.									
	Number tested .	—	—	—	13	38	30	15	5
	„ negative .	—	—	—	9	32	24	15	5
	Percentage negative	—	—	—	70	84	80	100	100
Institution for children :									
Initial immunity rate 62 per cent.									
	Number tested .	12	24	30	53	9	133	2	—
	„ negative .	6	14	24	29	8	87	2	—
	Percentage negative	50	58	80	54	89	65	100	—

The groups are very small and the statistical error therefore great. A summary of these results is given in Table III.

TABLE III.

Place.	Initial immunity percentage.	No. of positive reactors immunised and re-tested.	No. giving negative Schick test.	Weeks since last injection of mixture.	Percentage Schick-negative.
Institution for children	62	348	296	11	83
School B	72	136	133	11	98
School C	{ 69	101	92	8	91
	{ —	—	101	20	100

It may be of value to present the evidence in another way. A group of 136 “positive reactors” was injected and re-tested. Within

8 weeks 129, *i. e.* 94 per cent., showed a negative Schick reaction; thereafter the results were as follows, the figures in brackets giving the number yielding a Schick-negative reaction at the expiry of the corresponding number of weeks: 9 (2), 10 (1), 11 (1), 21 (2). One child, though reinjected, remained positive; we hope to be able to re-examine him later.

With regard to the permanence of the negative reaction in immunised children, we had the opportunity of re-testing a group of 203 children, both those originally negative to the Schick test, and also those who had become negative after immunisation. When re-tested 11 weeks later the reactions agreed in 201 cases; 2 who had been negative now gave a positive reaction. Inquiry revealed that these children had had antitoxin injected some few weeks before the first test was carried out.

To one question of interest we have only a partial answer. From our general knowledge of immunity it is to be expected that a school population showing a high percentage of Schick-negative reactors and having a recent history of diphtheria would be one easily immunised. This anticipation is realised in the large groups of figures given by Zingher. We know also from Dudley's careful work (1922) that a population of boys exposed to an epidemic of diphtheria will show a high percentage of "Schick-negative reactors." It would be of great scientific interest to know how many of the children would have become immune without the injection. Probably some few of them would. We have had unfortunately, in this, as in so many other aspects of this work, very restricted opportunities of making observations under satisfactory conditions; however, at one school, 19 children who gave Schick-positive reactions did not become available to us again for seven months, during which time the remainder of the positive reactors in the school were immunised. All of these 19 children were now injected. Five weeks after the completion of the course of injection these children were again tested; 5 of them gave a positive response. Thus, this group of 19 children who had been in contact with the other children and had also recently had prophylactic injections showed an immunity rate of only 74 per cent., whereas the children who had been fully immunised at this time gave a 99 per cent. immunity rate. Though the figures are small, they indicate that the increased immunity rate in the whole school was almost entirely the result of the toxin-antitoxin injections.

The figures from the welfare centre may be of further help. Of these children only 24 per cent. were Schick-negative reactors when they were first examined. Of 33 children tested, found positive and injected with mixtures, 31, *i. e.* 93 per cent. became Schick-negative reactors within 12 weeks. During this period no cases of diphtheria were notified within the area. Small groups of fresh children were still being tested each week, and the immunity rate was still between 25 and 30 per cent.

It is reasonable to conclude that in this particular population, the greater part of the conversion of the "Schick-positive" population to a "Schick-negative" one was due to the injections given.

Reactions after injection of toxin-antitoxin mixture.—The reactions in these groups of children have been very slight: with the exception of three instances in our early work we have no record that any child developed a

reaction and illness sufficiently severe to cause it to be confined to bed for one day. The great majority suffered nothing but a temporary slight soreness of the arm, and very few had any general reaction.

SUMMARY.

(1) The results of somewhat over 2700 Schick tests are given. The percentage immunity at various ages agrees generally with observations in the literature. The "higher" the social status of an urban population group, the lower will its immunity rate be.

(2) The results of the immunisation of 585 positive reactors are given. Between 85 per cent. and 98 per cent. of the positive reactors in the different groups became negative to the Schick test in less than three months.

(3) No serious reactions after injections of the toxin-antitoxin mixtures were observed amongst these children.

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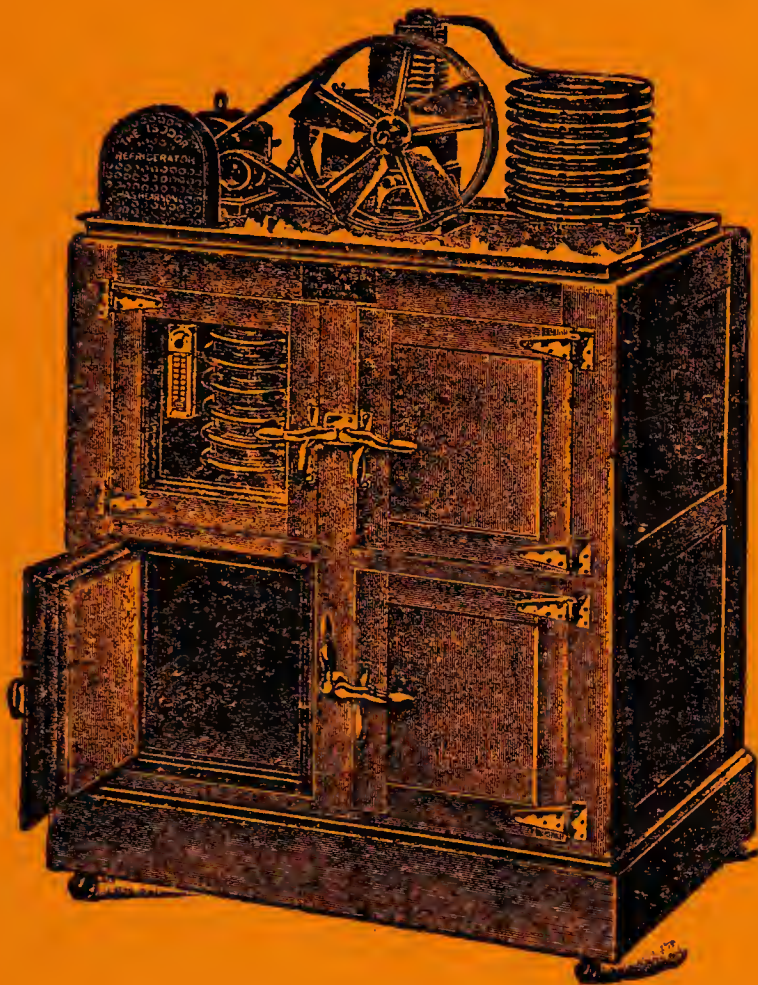
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VOL. IV, No. 1. FEBRUARY, 1923.

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